Recent Observations on Trinity River Delta *Rangia cuneata* and *Vallisneria americana* in relation to Freshwater Inflow

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Presented at the TSJ BBASC Meeting

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University of Houston Clear Lake

National Wildlife Federation

Outline

- Background
- Past Studies – Galveston Bay
- Methods
- Results
- Conclusions and Future Work

Atlantic Rangia - *Rangia cuneata*

Vallisneria americana
Tapegrass

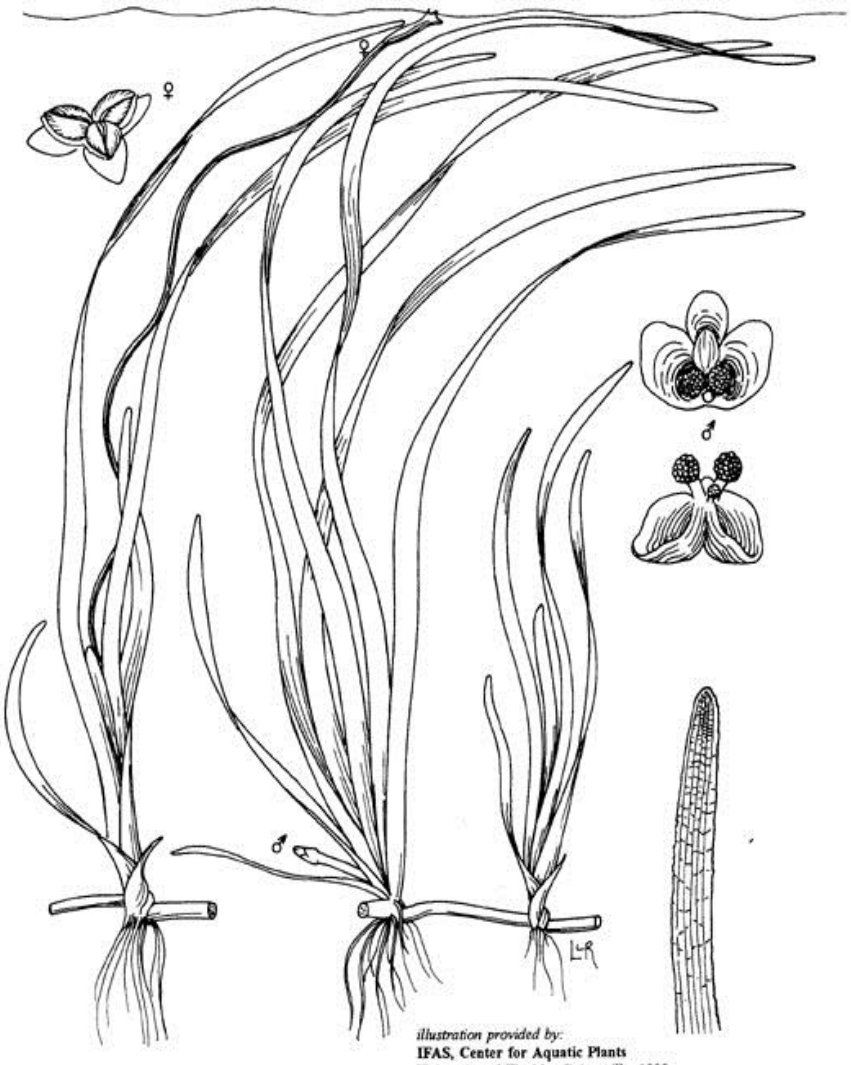


illustration provided by:
IFAS, Center for Aquatic Plants
University of Florida, Gainesville, 1990

https://plants.ifas.ufl.edu/wp-content/uploads/images/valame/valamedr.jpg

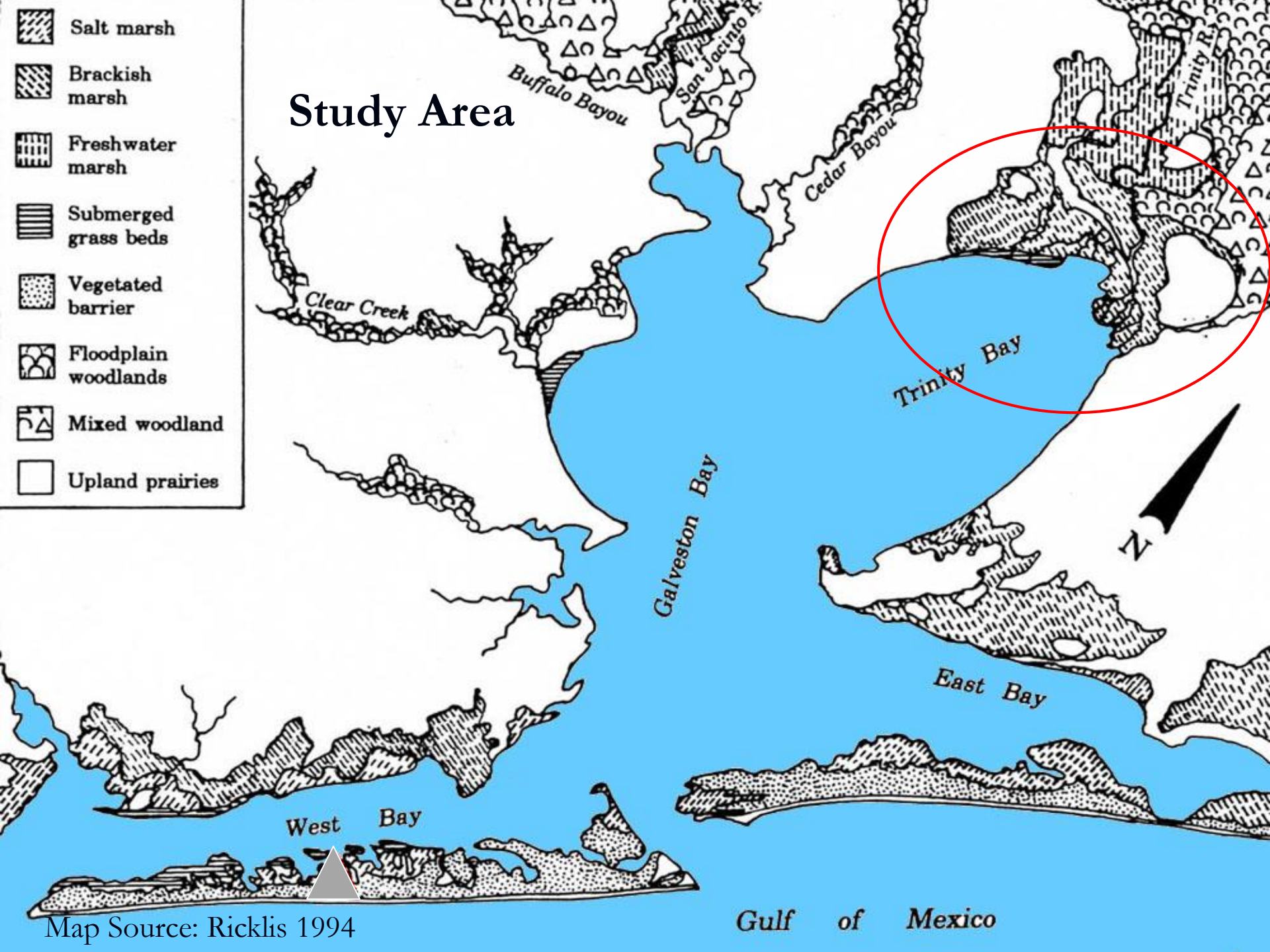
Vallisneria americana

- Water celery, eel-grass, tape-grass
- Freshwater to low salinity
- Submerged perennial
- Rounded tapered leaves, small white flowers

Past Studies – Galveston Bay

- TPWD Coastal fisheries data – trawl, bag-seine
  - Incidental captures coast wide – not effective gear
- Anil-Marshalleck et al. 2000.
  - Reviewed 1986-1998 Galveston Bay TPWD
  - Found highest densities in Trinity Bay
  - Trawl CPUE declined from 127/haul to 5/haul
  - 80% decline after 1989 freeze
  - No established fishery existed
- Parnell et al. (2011) – Galveston Bay (2010-11)
- Windham (2015) - Galveston Bay (2012-2014)

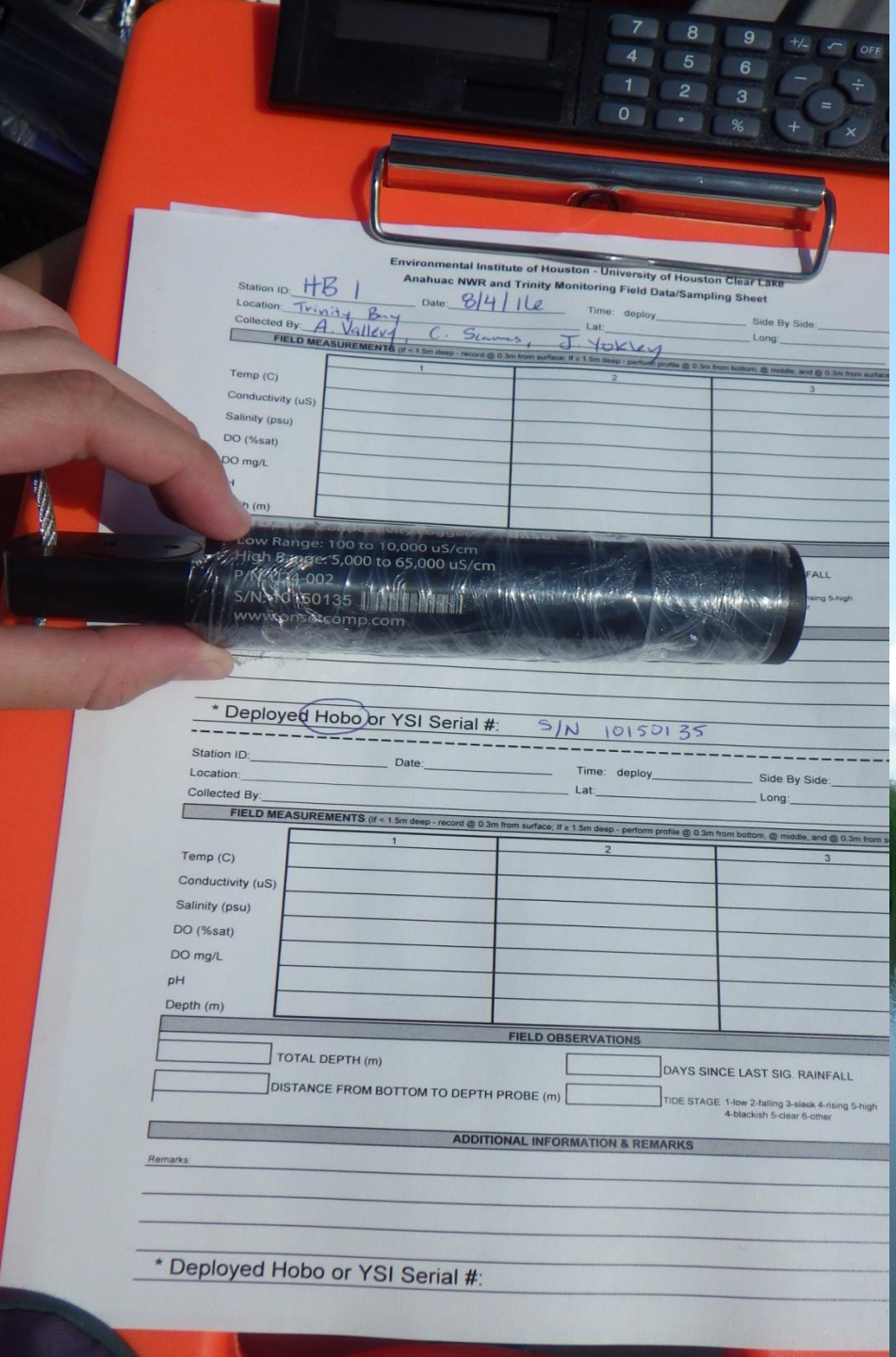
Current Field Studies



Map Source: Ricklis 1994

Methods

- Collection of new data – Jan-Feb 2016 (Rangia and Vallis., August-Sept 2016 (Vallis.)
- Used airboat, multiple gear
- Compare Rangia data to recent published data from Trinity Delta- includes recent drought years
  - Parnell (2011)
  - Windham (2015)
- River discharge, temp, salinity, d.o.,turbidity, sed. Size.
- Evaluate change in Rangia occurrence, density, and condition (organic/total weight), morphometric



Environmental Institute of Houston - University of Houston Clear Lake

Anahuac NWR and Trinity Monitoring Field Data/Sampling Sheet

Station ID: HB 1 Date: 8/4/16 Time: deploy Side By Side:

Location: Trinity Bay Lat: Long:

Collected By: A. Valley, C. Stevens, J. Yokley

FIELD MEASUREMENTS (if < 1.5m deep - record @ 0.3m from surface. If ≥ 1.5m deep - perform profile @ 0.3m from bottom, @ middle, and @ 0.3m from surface)

	1	2	3
Temp (C)			
Conductivity (uS)			
Salinity (psu)			
DO (%sat)			
DO mg/L			
pH			
Depth (m)			

Low Range: 100 to 10,000 uS/cm

High Range: 5,000 to 65,000 uS/cm

P/N 3014-002

S/N 10150135

www.ysicomp.com

FALL

rising 5-high

* Deployed Hobo or YSI Serial #: S/N 10150135

Station ID: Date: Time: deploy Side By Side:

Location: Lat: Long:

Collected By:

FIELD MEASUREMENTS (if < 1.5m deep - record @ 0.3m from surface. If ≥ 1.5m deep - perform profile @ 0.3m from bottom, @ middle, and @ 0.3m from s

	1	2	3
Temp (C)			
Conductivity (uS)			
Salinity (psu)			
DO (%sat)			
DO mg/L			
pH			
Depth (m)			

FIELD OBSERVATIONS

TOTAL DEPTH (m)

DISTANCE FROM BOTTOM TO DEPTH PROBE (m)

DAYS SINCE LAST SIG. RAINFALL

TIDE STAGE 1-low 2-falling 3-slack 4-rising 5-high 4-blackish 5-clear 6-other

ADDITIONAL INFORMATION & REMARKS

Remarks:

* Deployed Hobo or YSI Serial #:

Top View

Side View

A

B

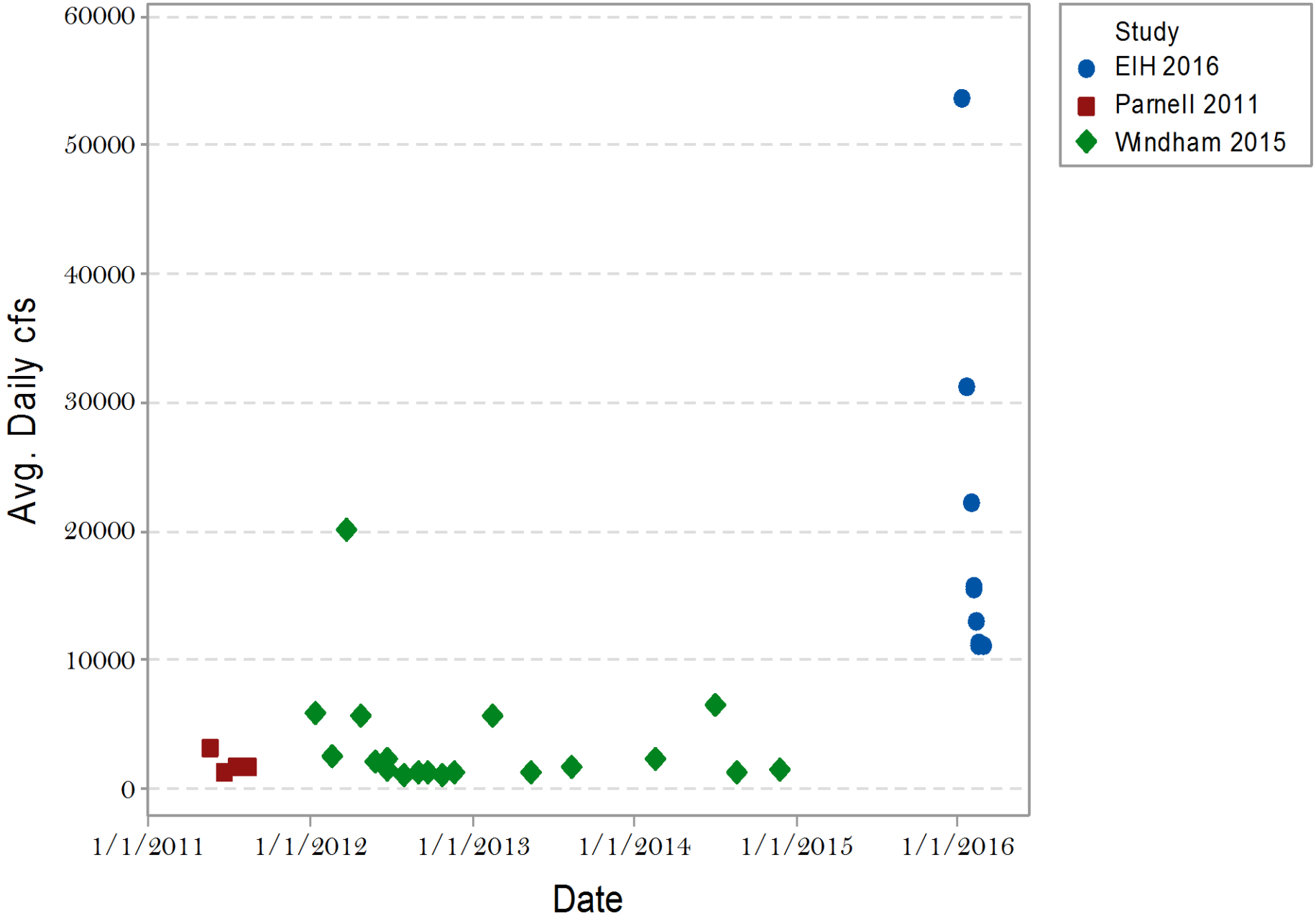
C

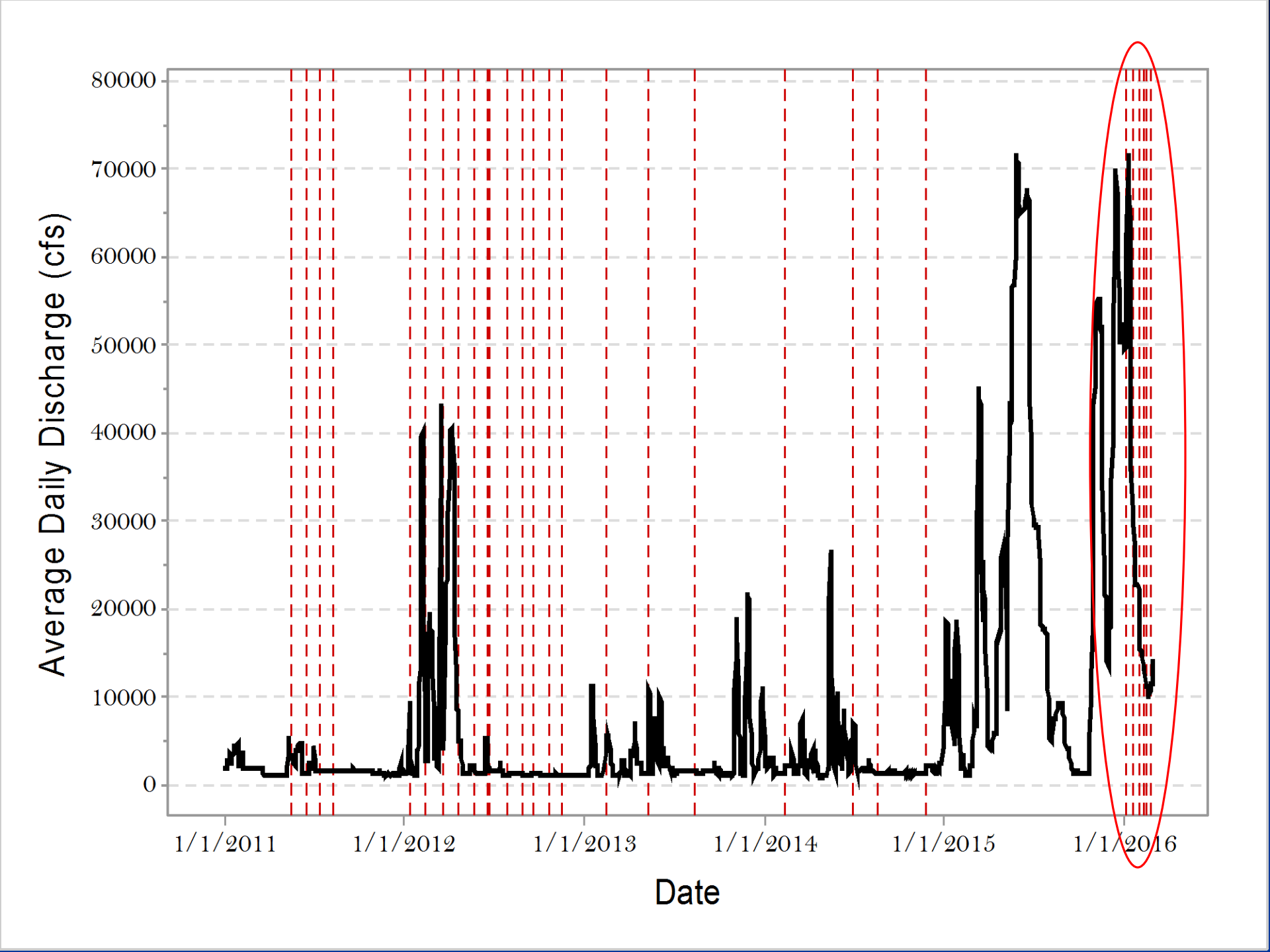
Figure 3. Clam dredge used at sites > 1m depth. Top: top view of dredge (imitates position of deployment on the substrate). Bottom: side view of clam dredge.

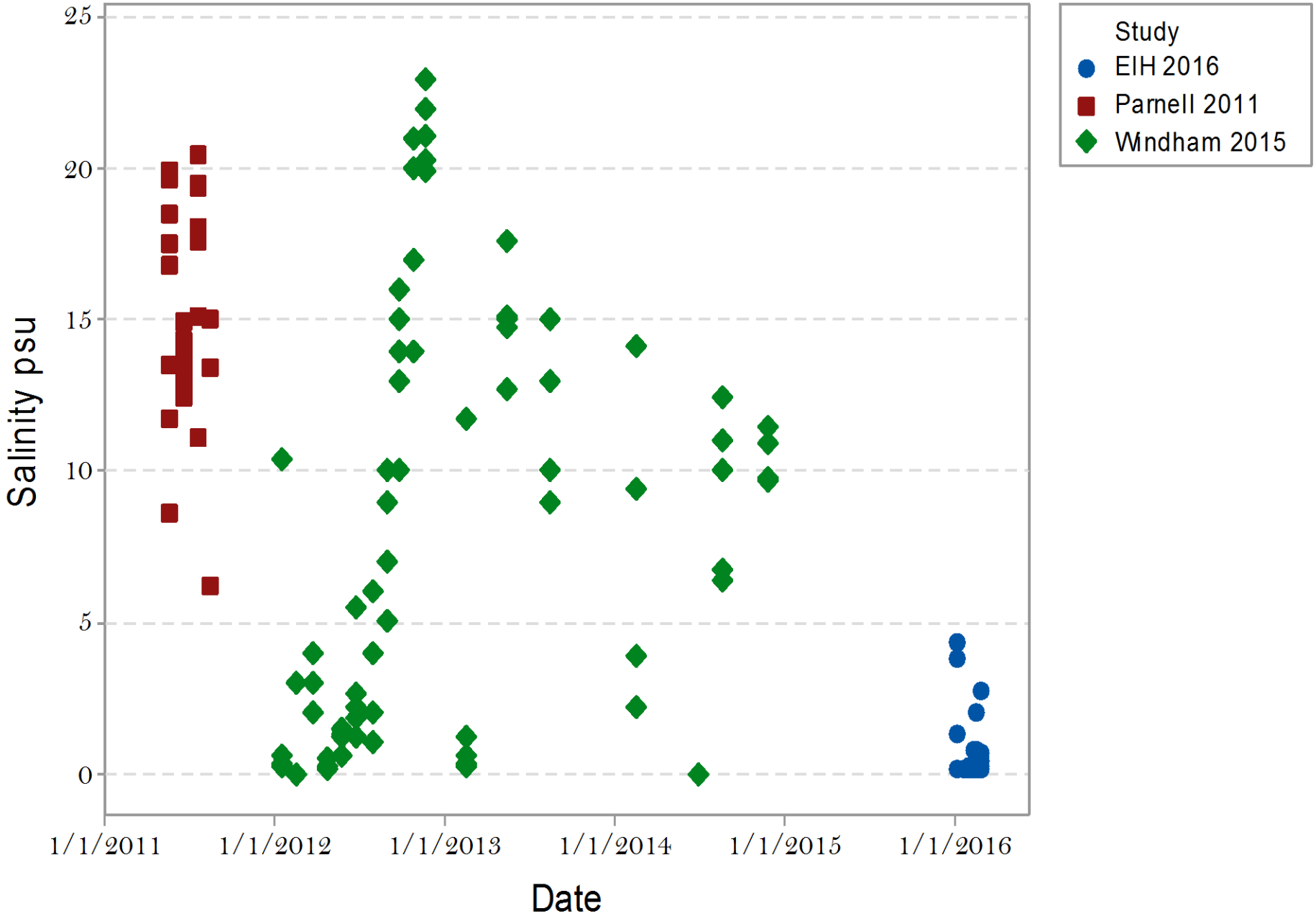

Water celery


01/07/2016 10:50

Results

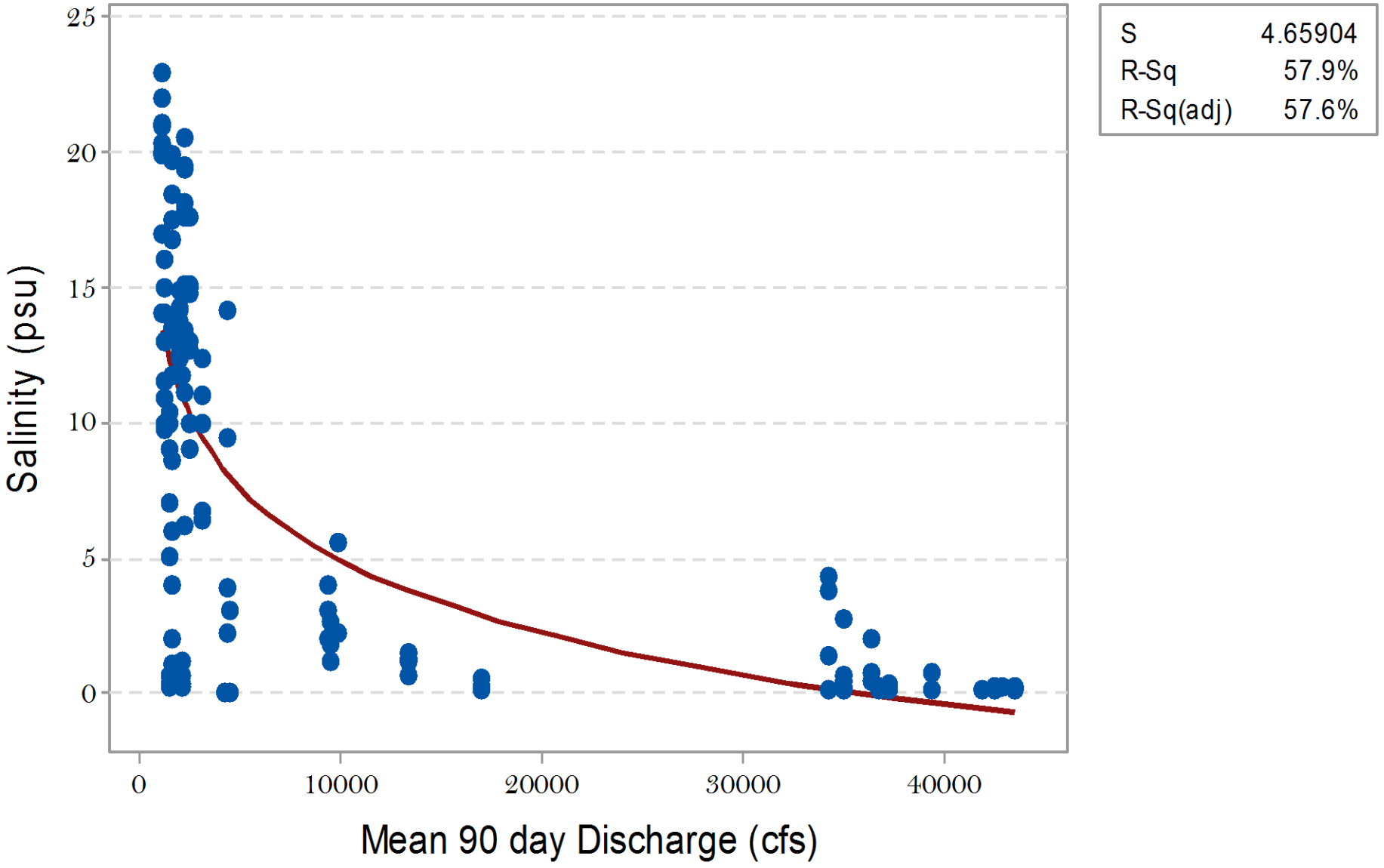

60000
50000
40000
30000
20000
10000
0
Avg. Daily cfs
1/1/2011
1/1/2012
1/1/2013
1/1/2014
1/1/2015
1/1/2016
Date
Study
EIH 2016
Parnell 2011
Windham 2015


80000
70000
60000
50000
40000
30000
20000
10000
0
Average Daily Discharge (cfs)
1/1/2011
1/1/2012
1/1/2013
1/1/2014
1/1/2015
1/1/2016
Date


Study
EIH 2016
Parnell 2011
Windham 2015
Salinity psu
25
20
15
10
5
0
1/1/2011
1/1/2012
1/1/2013
1/1/2014
1/1/2015
1/1/2016
Date

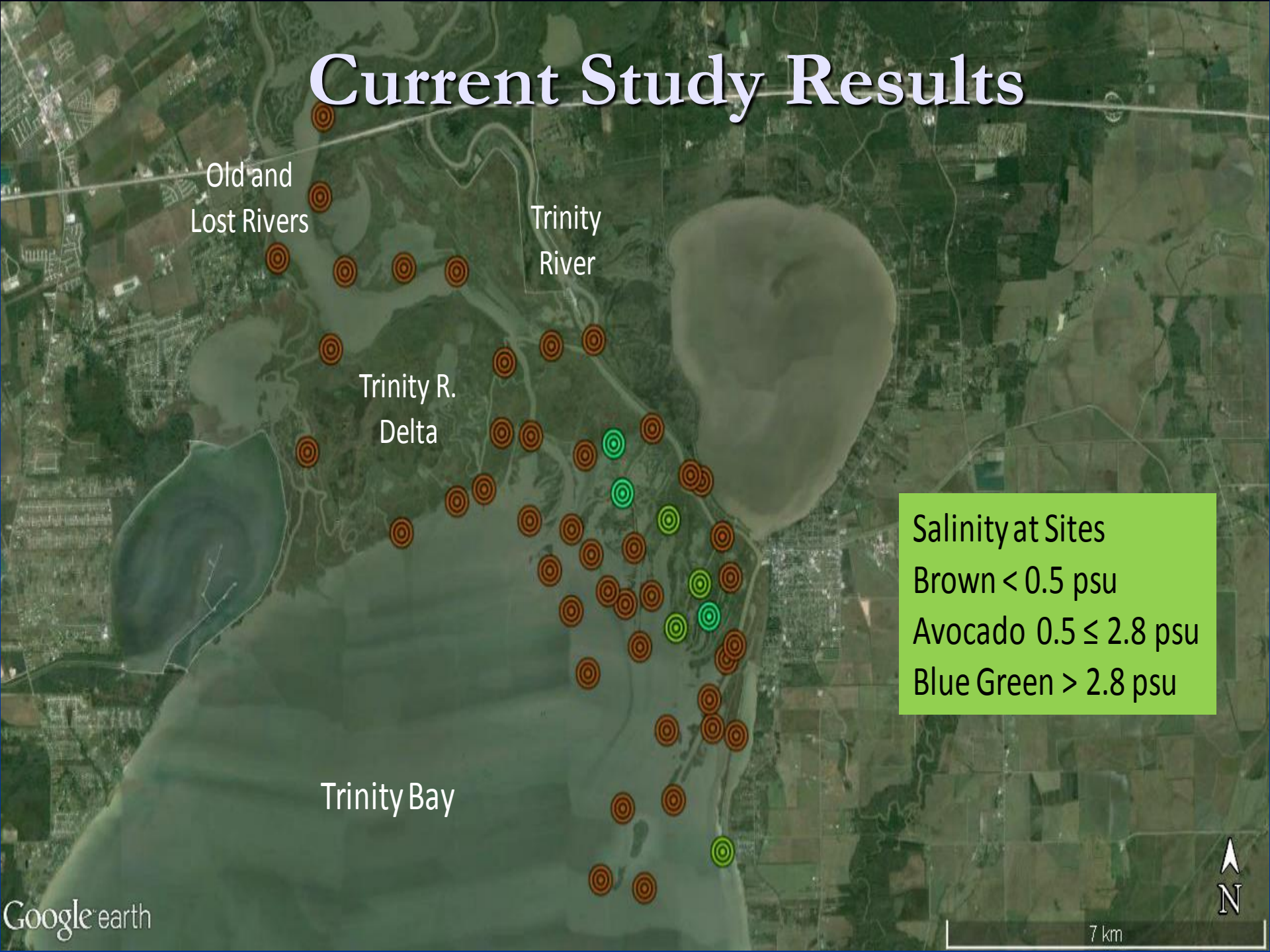
Fitted Line Plot

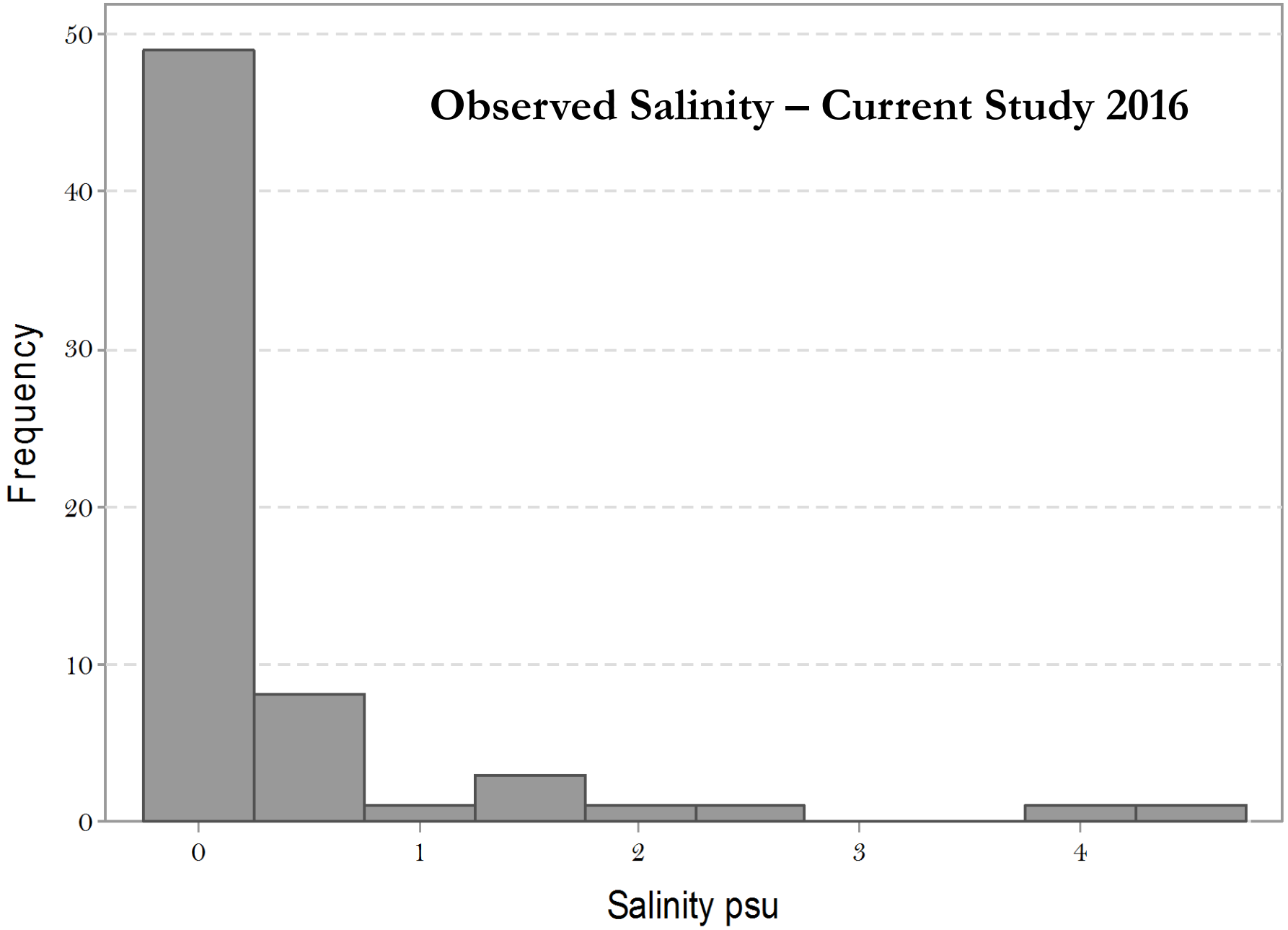
Sal psu = 40.09 - 8.812 log10(Avg90d)

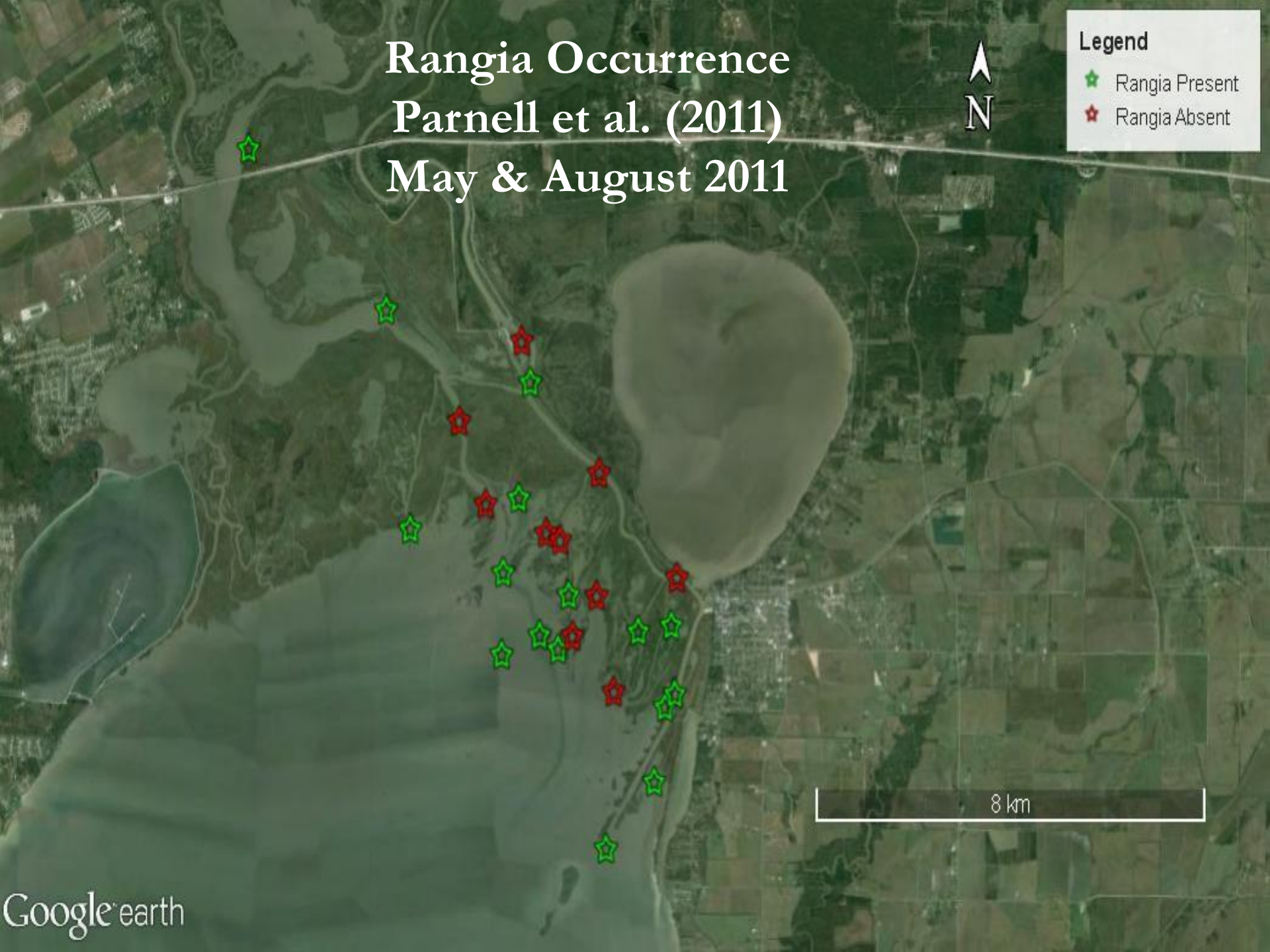


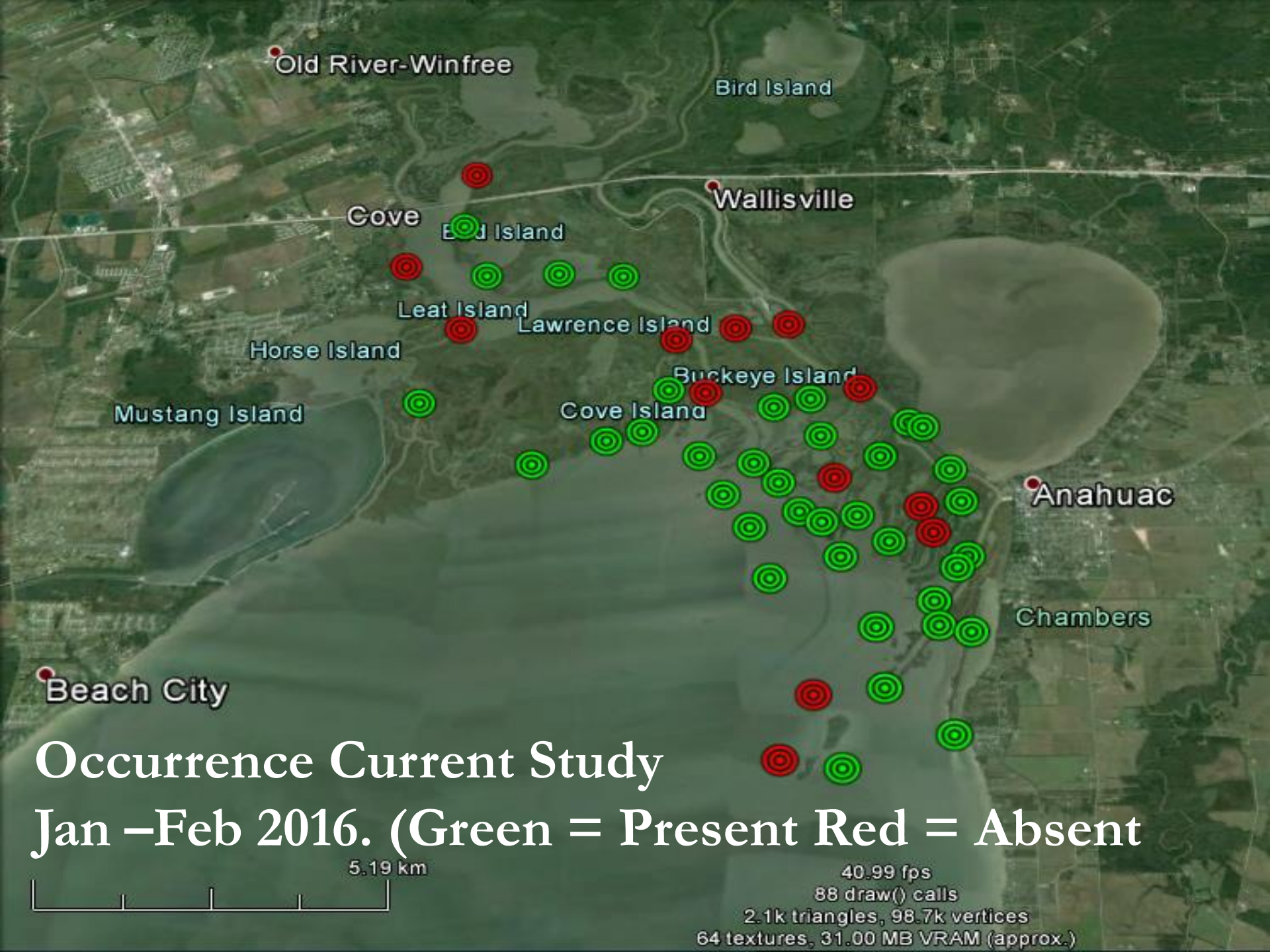
S	4.65904
R-Sq	57.9%
R-Sq(adj)	57.6%

Current Study Results

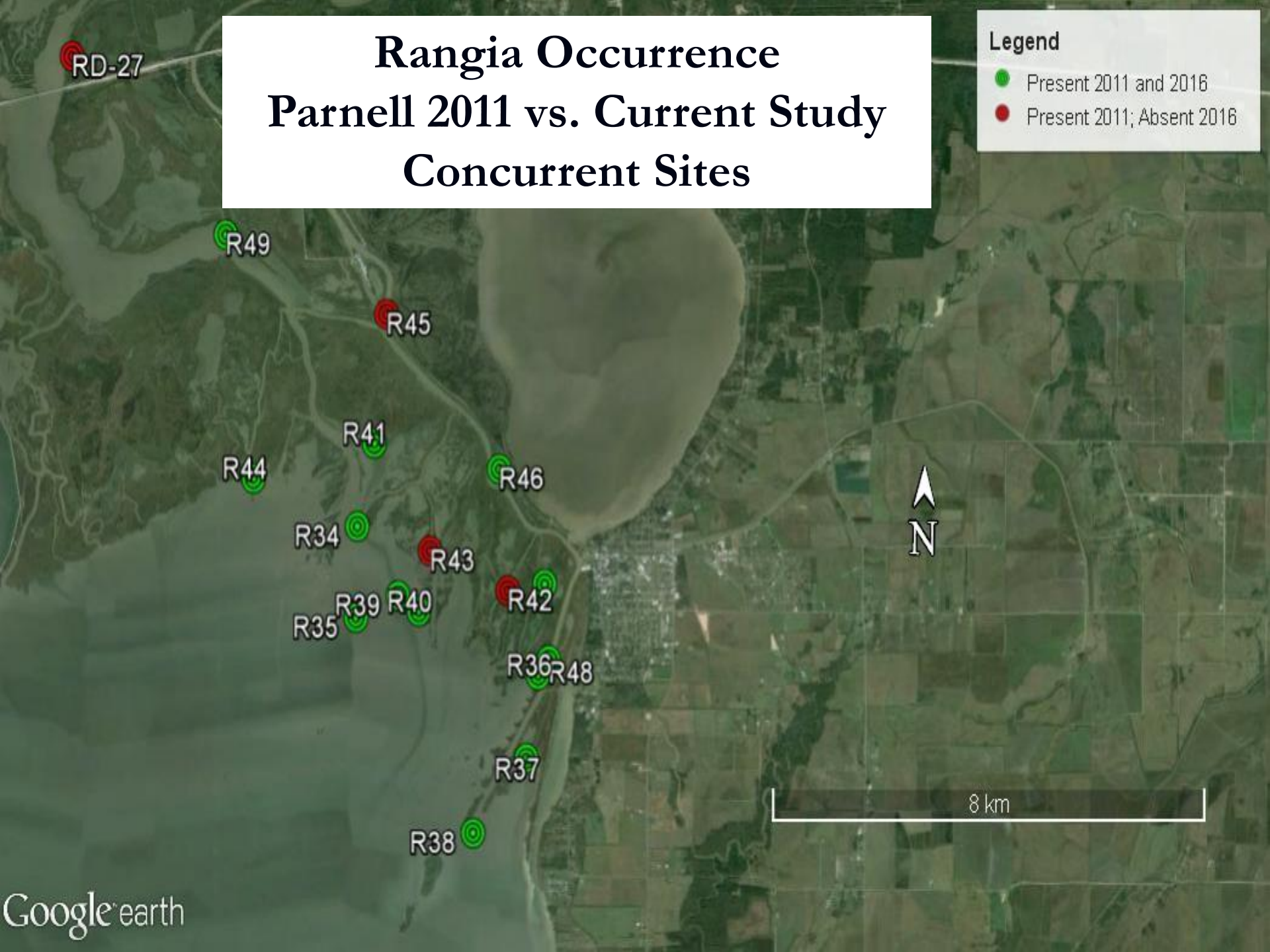


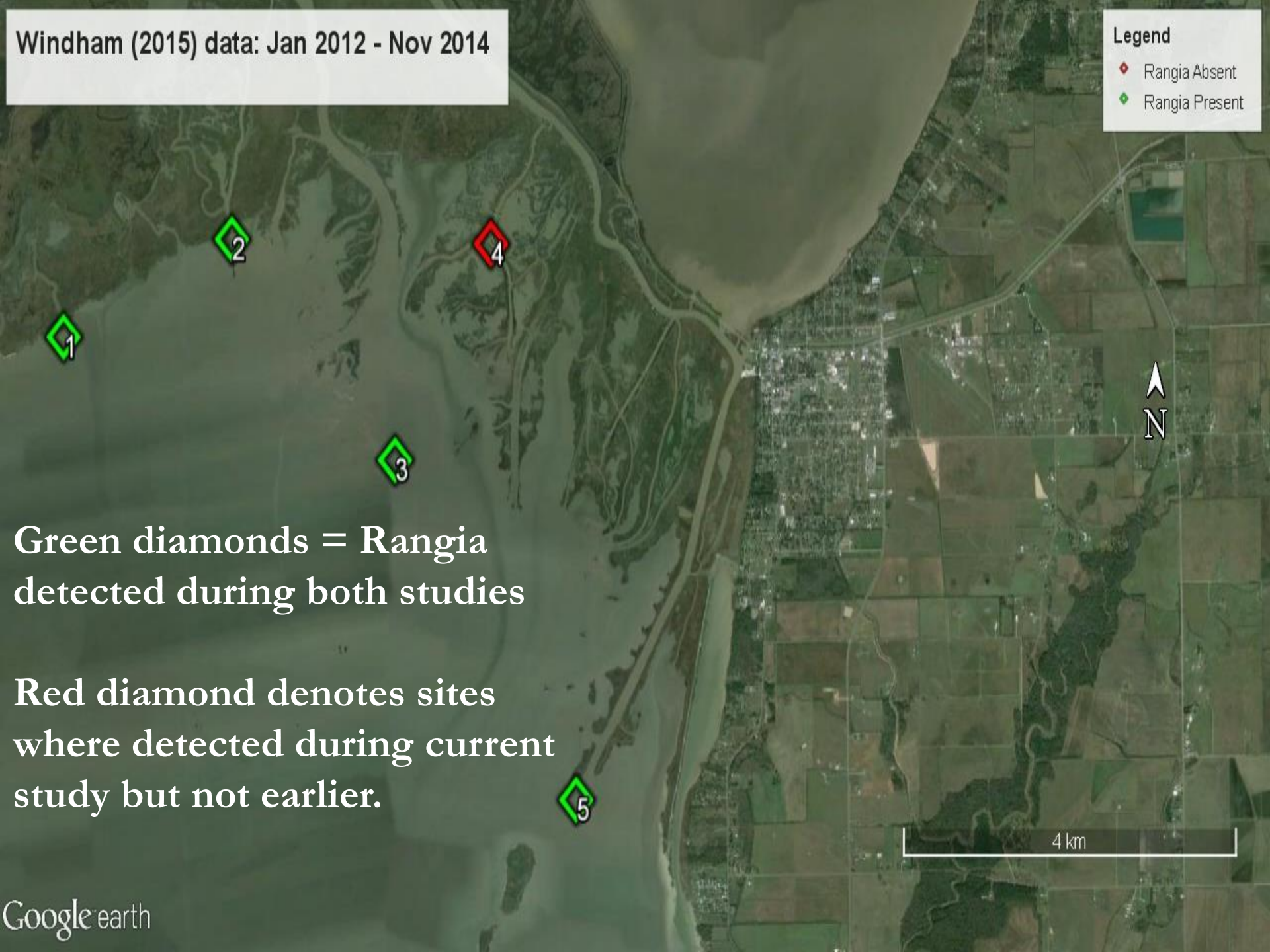

Observed Salinity – Current Study 2016
Frequency
50
40
30
20
10
0
0
1
2
3
4
Salinity psu


Rangia Occurrence
Parnell et al. (2011)
May & August 2011
N
Legend
Rangia Present
Rangia Absent
8 km
Google earth



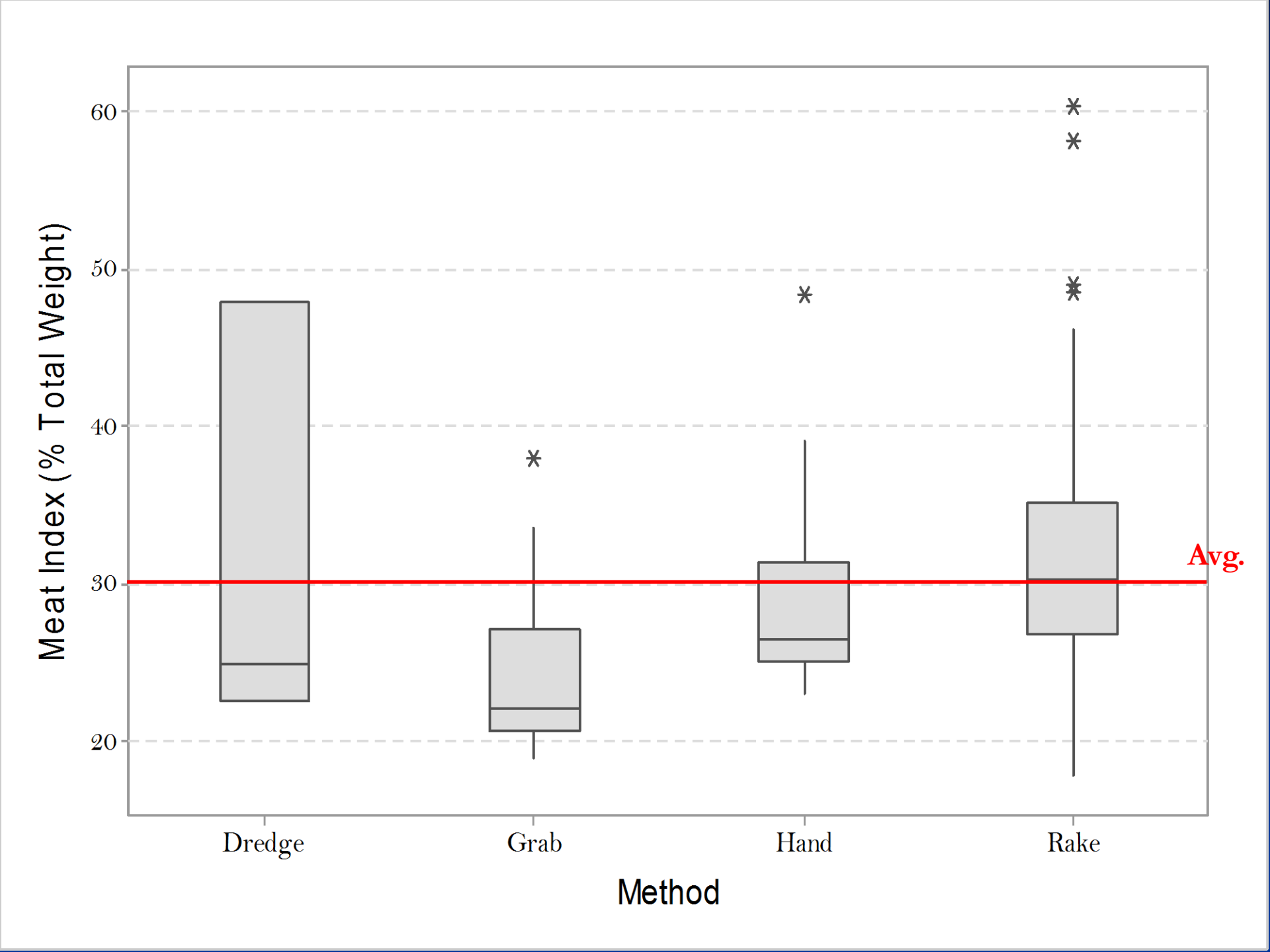
Occurrence Current Study
Jan –Feb 2016. (Green = Present Red = Absent


Rangia Occurrence
Parnell 2011 vs. Current Study
Concurrent Sites
Legend
Present 2011 and 2016
Present 2011; Absent 2016
RD-27
R49
R45
R41
R44
R46
R34
R43
R39
R40
R42
R35
R36
R48
R37
R38
N
8 km
Google earth



Green diamonds = Rangia detected during both studies

Red diamond denotes sites where detected during current study but not earlier.


60
50
40
30
20
Meat Index (% Total Weight)
Avg.
Dredge
Grab
Hand
Rake
Method

Comparison of MI to Past Studies

- The average meat index (% total weight) observed during this study was 30.3 ± 0.5%.
- Parnell et al. (2011), reported an average meat index of 12.5% during May to August 2011.
- Annual average meat index values in Trinity River delta and open waters during 2012-2014 were approximately 12% (Windham 2015).

Other Mollusk Species Observed

- Live:
  - Brown Rangia - *Rangianella flexuosa* (1) – included in Rangia count
- Recently dead (both valves attached):
  - Carolina marshclam – *Polymesoda caroliniana* (1)
  - Round Pearlshell – *Glebula rotundata* (1)

Vallisneria

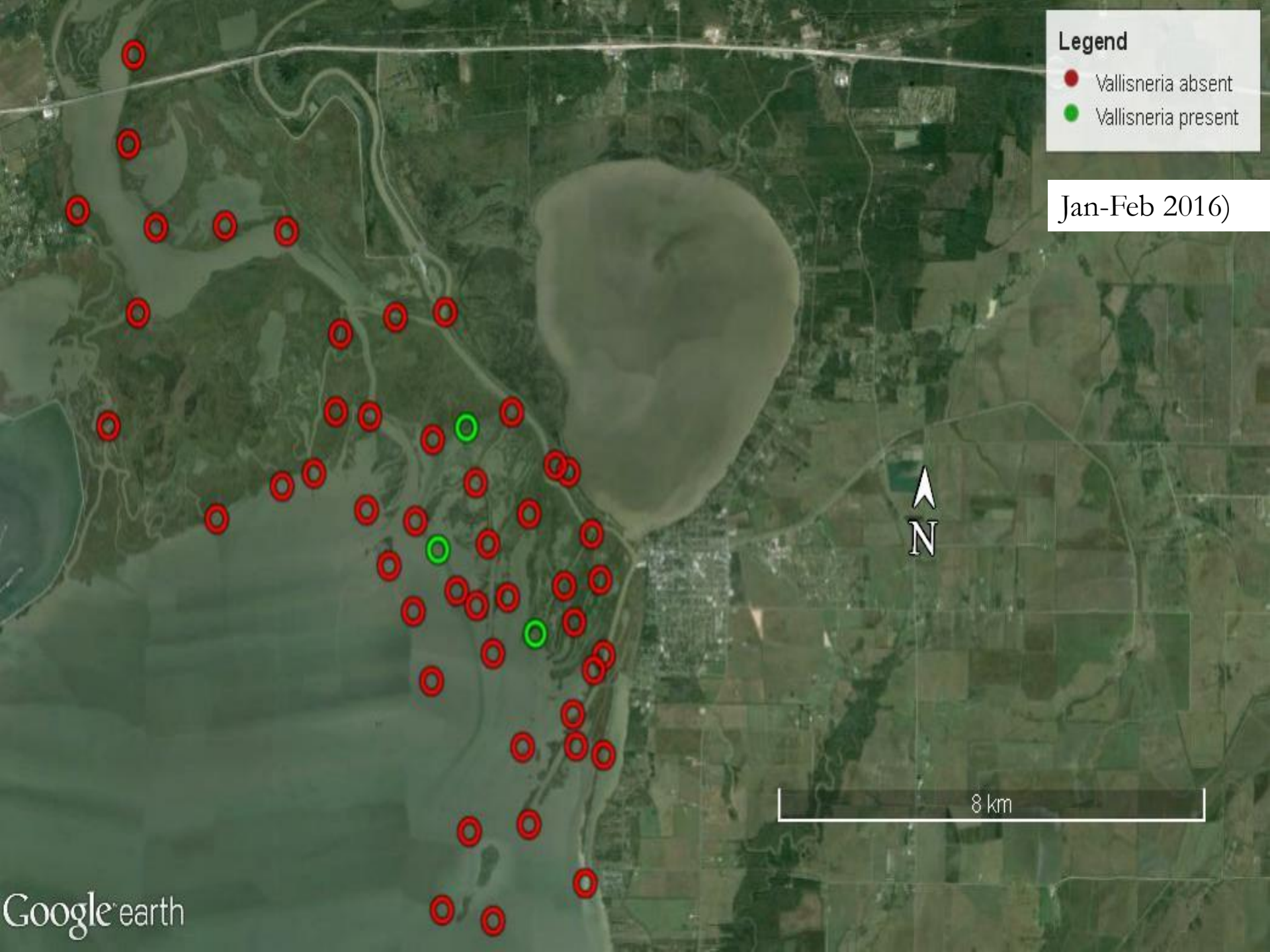
February 25, 2016


02/25/2016 11:47

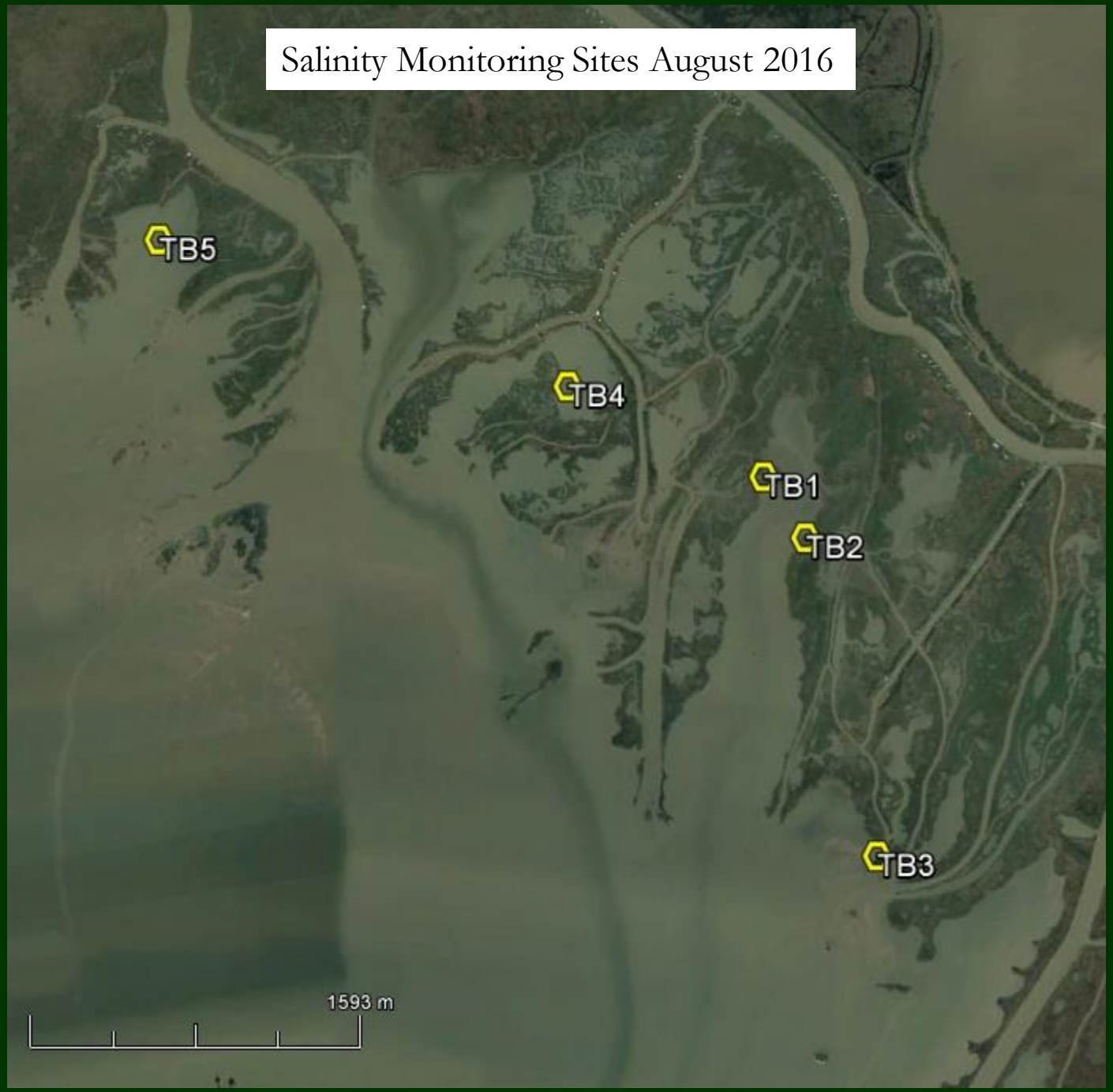

April 12, 2016
04/12/2016 08:50

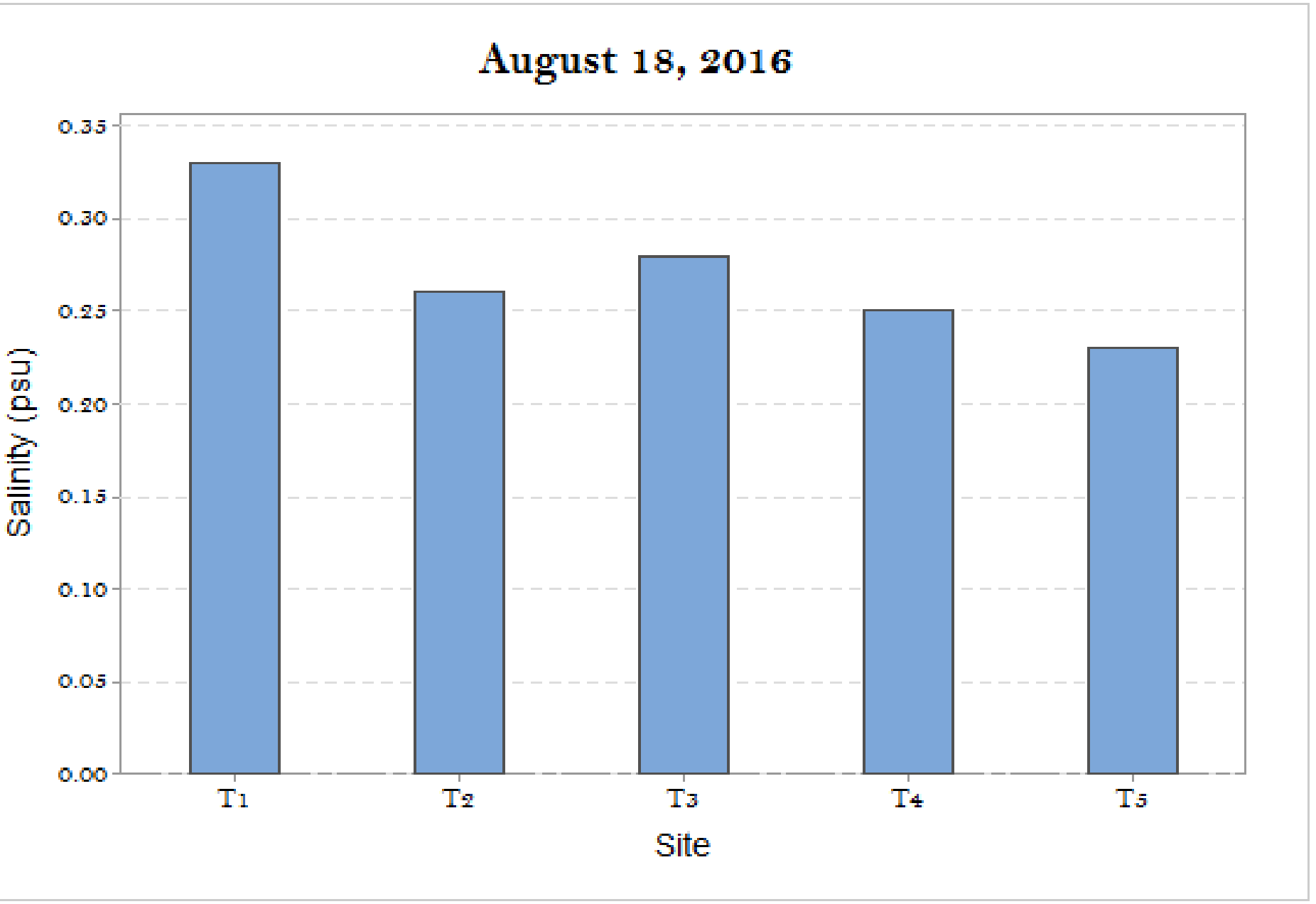

August 3, 2016


August 3, 2016

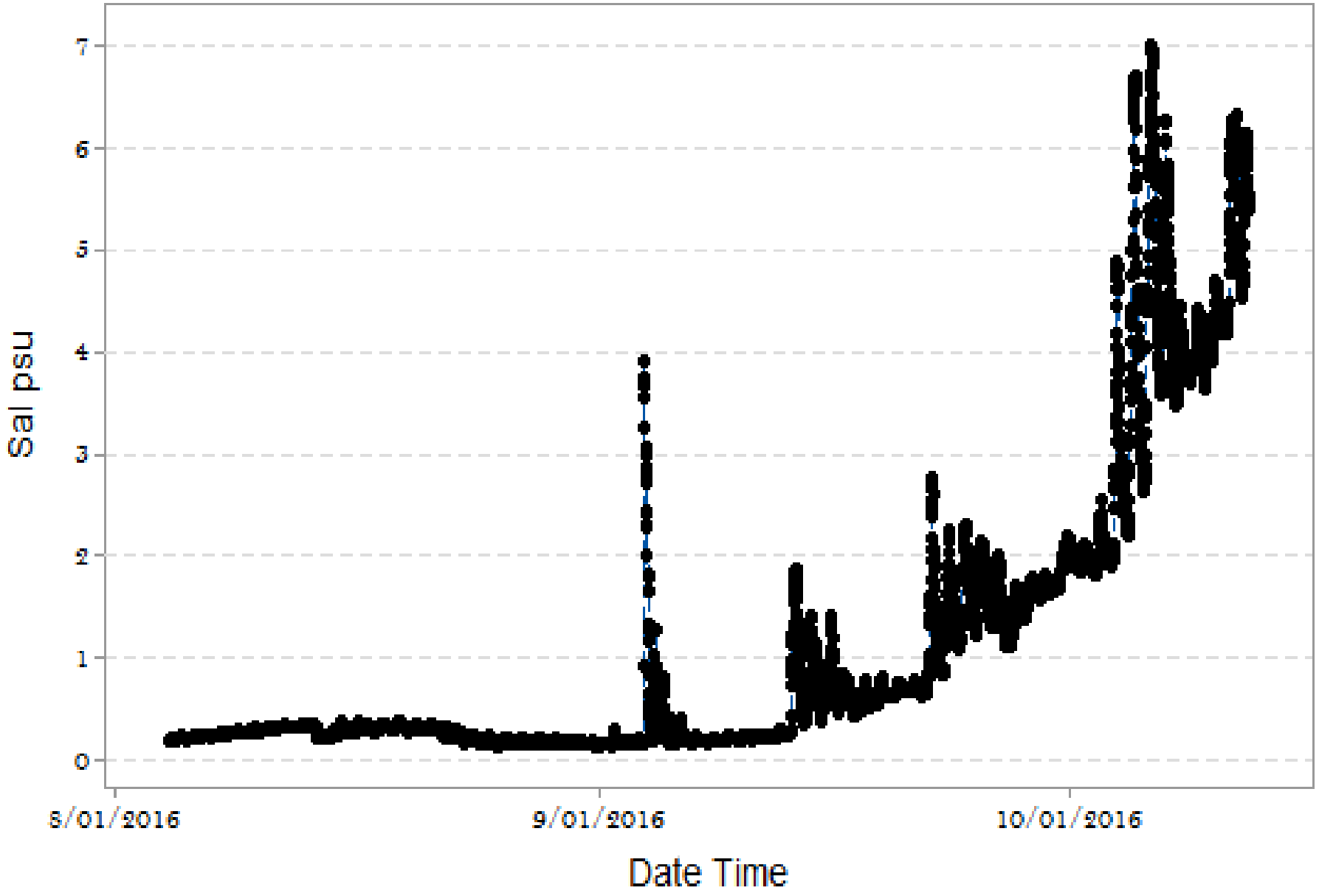

Legend
Vallisneria absent
Vallisneria present
N
8 km
Google earth

Jan-Feb 2016)


Salinity Monitoring Sites August 2016
TB5
TB4
TB1
TB2
TB3
1593 m


August 18, 2016
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Salinity (psu)
T1
T2
T3
T4
T5
Site

Salinity Trends at Trinity Bay Delta August-October 2016




Vallisneria present – April – August 2016
5.69 km
824 m


Vallisneria beds present –August 2016 – total approx. 3000 m2
824 m

V. americana

- Detected at multiple sites in lower Trinity delta
- Not observed in previous surveys (Parnell et al. 2011; Quigg and Steichen 2015; Windham 2015) during dry periods.
- Alford (NRCS) reported seeing water celery in 2015 (- cited in Parnell et al. 2011).
- During 2015-16 river discharge likely reduced salinities from median of 5-10 psu during 2014 to < 3 psu during early 2016 which is more supportive of longterm *V. americana* survival (Frank and Moore 2003; Dobberful et al. 2012).

Conclusions

- Positive relationship between Trinity River discharge and salinity in delta observed.
- Recent sightings of water celery suggest freshwater inflow has created conditions supportive of this species.
- Difficult to discern any pattern in abundance or P/A of Rangia between years and river discharge and salinity. Differences in sampling methodology??
- Meat index increased during periods of higher freshwater inflow (lower salinity) 2016 vs. drought years (2011-2014)

Recommendations

- Future monitoring at index sites and random grid needed to increase statistical power and evaluate trends.
- Incorporation of automated sondes (SCT) in shallow water (sheet flow)
- Incorporate other bioindicators
  - Benthic community composition
  - Epibenthic organisms in SAV and non-SAV sites
- Modify deepwater benthic dredge (longer teeth) – increase effectiveness in deeper water

Recommendations

- Adjust detection probability of *V. americana* for effects of water clarity
- Potential incorporation of UAV or other remote sensing survey methodology

Acknowledgements

- National Wildlife Federation
- Environmental Institute of Houston
- Stephen Curtis – EIH Senior Biologist (now TPWD)
- Graduate Students: Nicole Morris, Kristopher Warner

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- O'Connell, M.T. et. al. 2005. Biological resources of the Louisiana coast: part 2. Coastal Animals and Habitat Associations. Journal of Coastal Research 44: 146-161.

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- Tunnell, J.W. Jr, N.C. Barrera, and F. Moretzosh. 2012. Texas Seashells: a field guide. Texas A&M Press.
- Windham, R. A. 2015. Rangia as potential indicators of bay health. Texas A&M University, Galveston, Texas

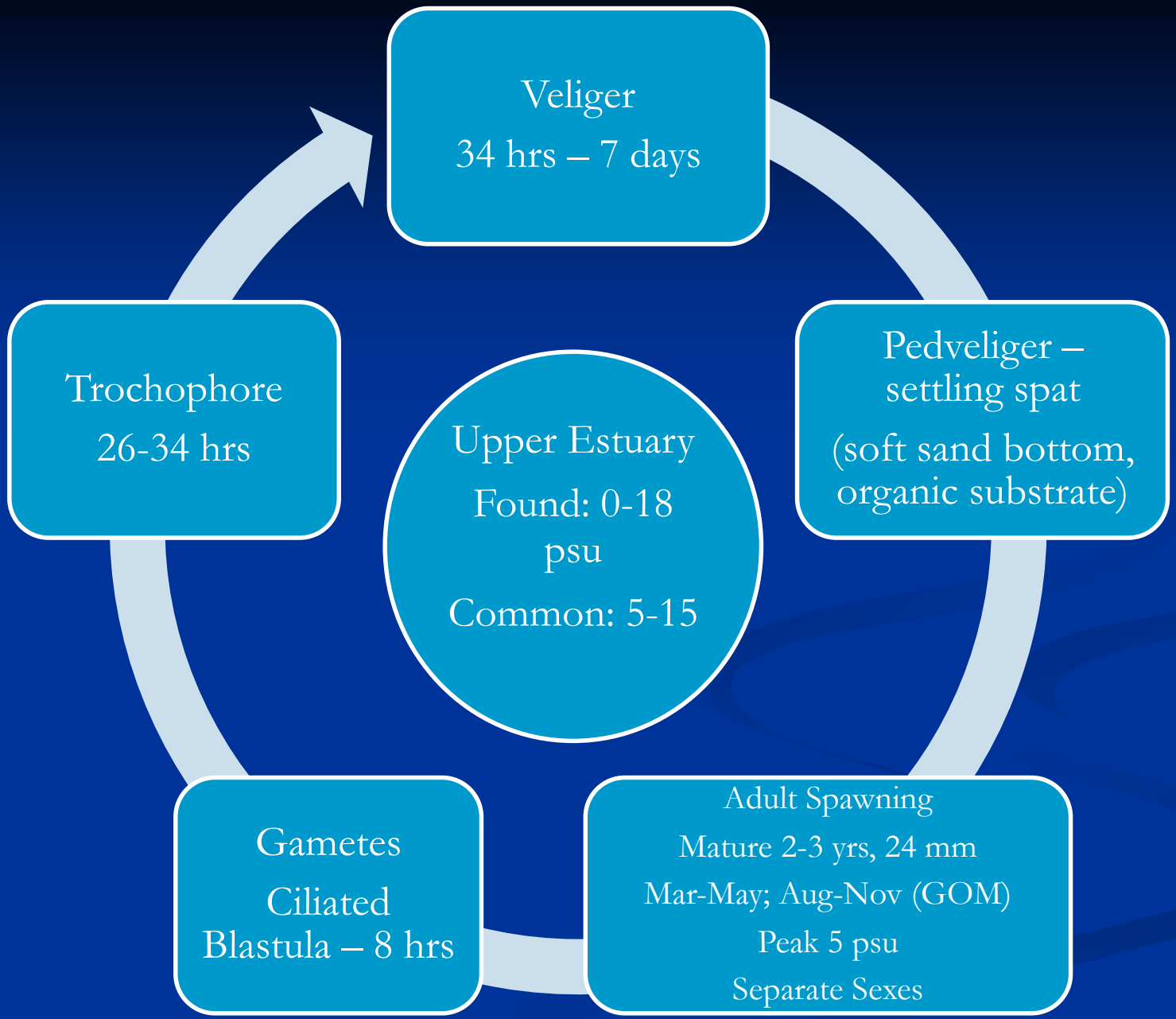
Questions?

Extra Slides

Gear Specifications	Effort
PVC Benthic corer – internal diameter = 4”; internal height (length) = 28.75” with end cap and handle and vacuum control hole	3 replicates at sites with high hand content. Each replicate = 12.56 in^2 = 81 cm^2. Used to sample Rangia, benthos and sediment.
Ekman benthic sampler (length x width = 6 X 6”); maximum internal depth of sample = 7.5’	3 replicates at sites with high silt Each replicate = 36 in^2 = 232.3 cm^2. Used to sample Rangia, benthos and sediment.
Petite ponar benthic sampler (length = 6”; width 8.25”) maximum internal depth = 9”.	3 replicates at sites with high clay/silt Each replicate = 49.5 in^2 = 319.4 $cm^{2.}$ Used to sample Rangia, benthos and sediment.
Clam dredge (width = 16”; depth 10.75”; length = 32” total trawl length w/o cod end basket extended dredge teeth to tow eyelet); cod end basket height = 8.25”; dredge teeth = 2”; gap distance between dredge teeth = average 2”; internal wire basket mesh size = 0.5” square mesh	3 – 30 second replicate tows at sites with depth exceeding Used to sample Rangia and large mollusks.
Clam rake (width = 13.75”; depth 5.75”; height 9” basket only; handle + basket length = 84”; teeth length = 3.25”; gap distance between = 1”; internal wire basket mesh size = 0.5” square mesh	3 – 6 replicate pulls for distance of 3-7’; < 4’ depth. Used to sample Rangia and large mollusks.
1 m^2 PVC quadrat	1 replicate per site to characterize vegetation cover of bottom.

Freshwater Inflow Management

- Estuaries characterized by varying freshwater inflow which influence salinity, sediment and nutrient transport
- FW Diversions for human use increasing
- Senate Bill 3 – requires TCEQ to adopt by rule appropriate environmental flows
- Use of and ecological indicators
- Indicator – sensitive to changing fw inflow and related variables (e.g. salinity, nutrients, sediment)
- *Rangia cuneata* – recommended indicator by SB3 guidance

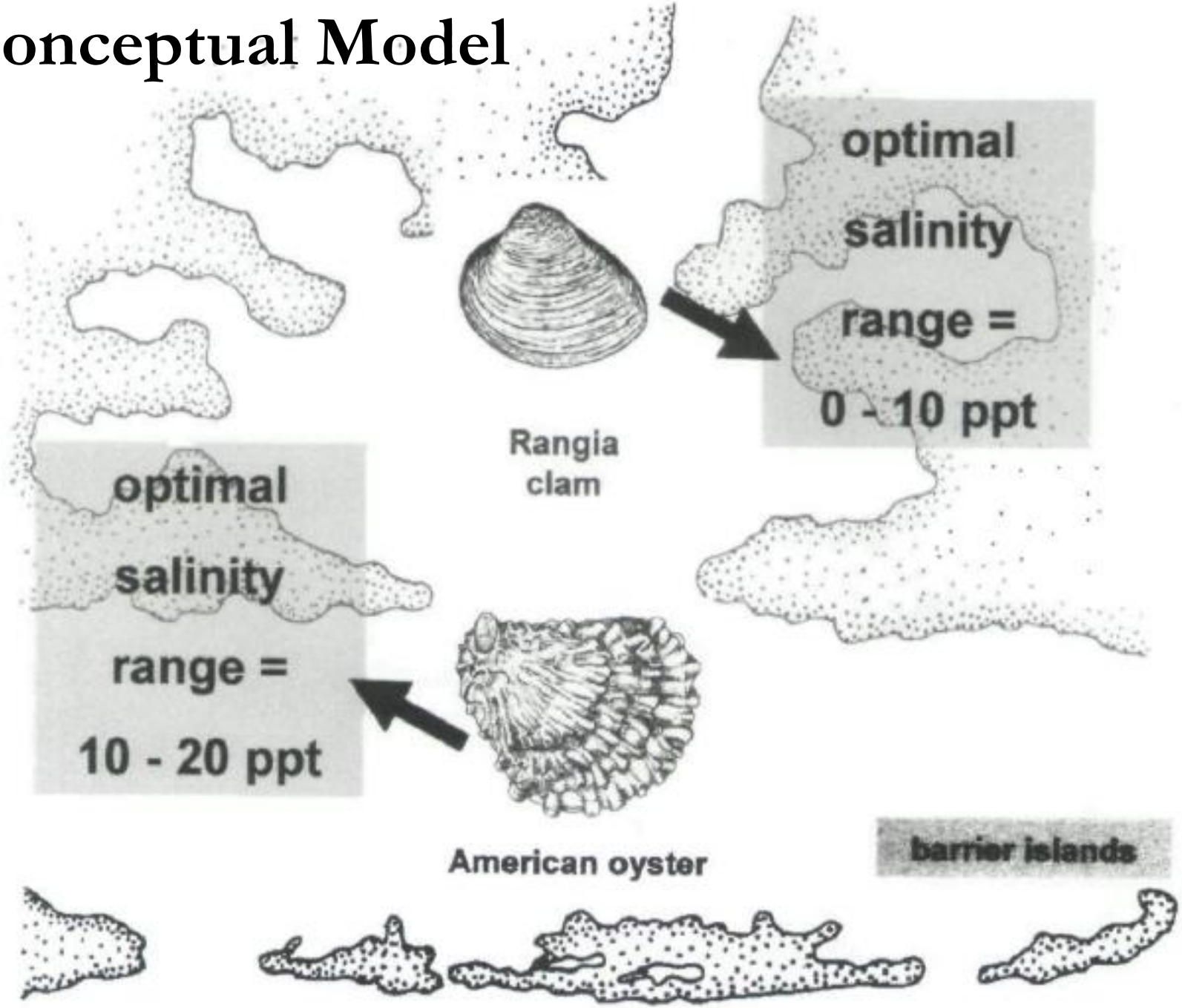


Life Cycle *Rangia cuneata*

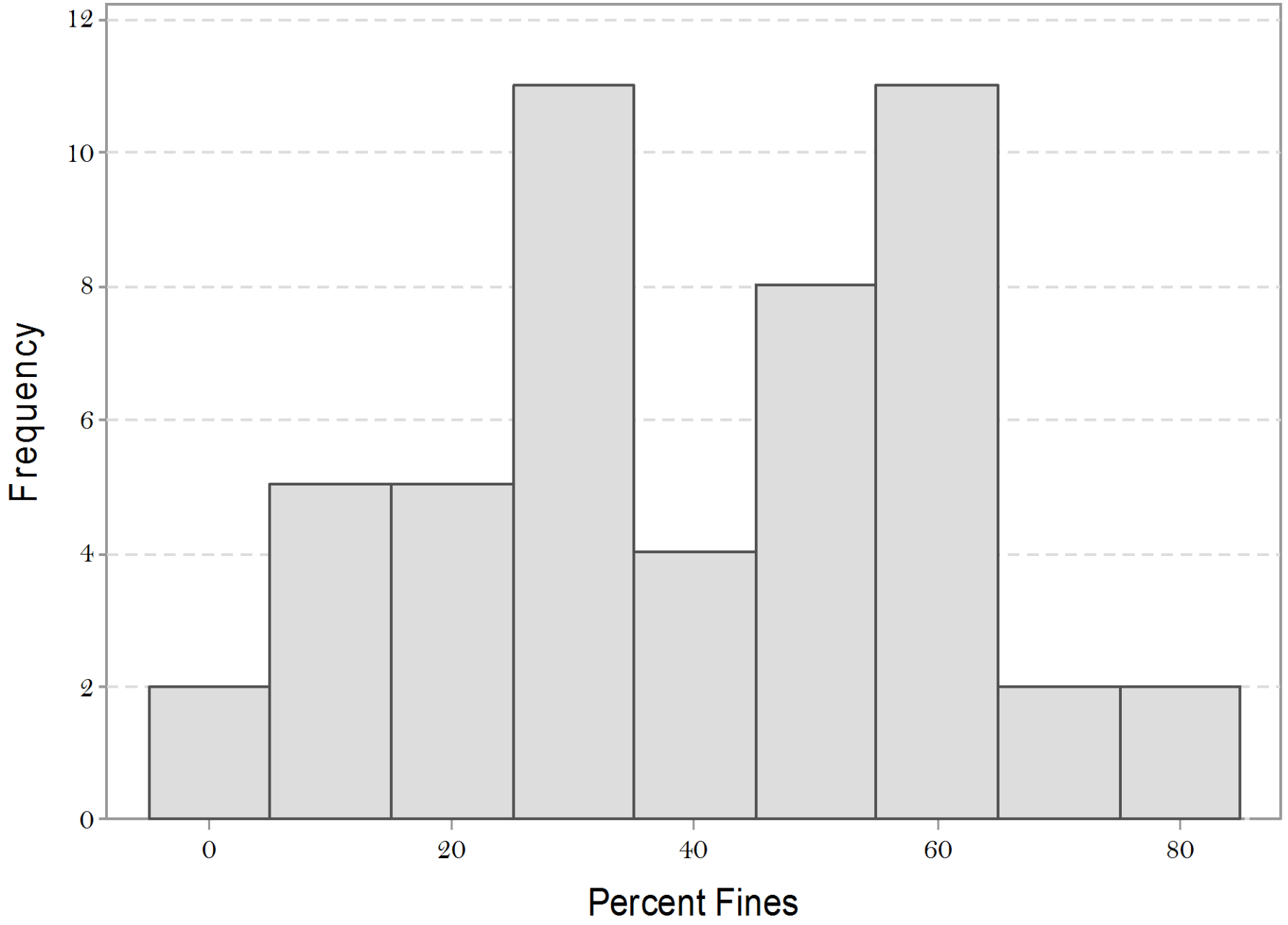
Factors Affecting Distribution

- Freshwater inflow
  - Substrate – mud to sandy silt, organic
  - Salinity
  - Nutrient regime?
- Ecological services:
  - Water quality filtration
  - Substrate for oysters during drought years
  - Food for fish, crabs, wading birds
- Human use – shell middens, limited fishery, shell dredging

Conceptual Model



Source: O'Connell et al. (2005)


12
10
8
6
4
2
0
Frequency
0
20
40
60
80
Percent Fines